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Disembodied Consciousness and the Transcendence of the Limitations of the Biological Body

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This paper looks at embodiment from a cross-disciplinary perspective. The notion that embodiment is an essential requirement for conscious awareness is explored using both a scientific and religious approach. Artificial intelligence, transhumanism and cybernetics are discussed as they force a pragmatic approach to defining and understanding situated embodiment. The concept of human immortality or extended longevity is also investigated as this further exposes the myths of transcending corporeality and also helps to explain the mission of transhumanism.

This paper is concerned with how we existing humans might either live in our present bodies for greatly extended life spans, or how we might copy ourselves to a medium more suitable than our present biological bodies to increase longevity. Any discussion regarding the possibility of augmenting or transcending our existing biological bodies must include the apparent non-physical aspects of embodiment—consciousness, self, mind and psyche. It is my contention that disembodied consciousness is an impossibility. This argument necessarily requires a discussion which includes scientific concepts and various religious and spiritual systems. I show that our bodies are not *merely* life support systems for a mind or self, but that mind and body are absolutely interdependent.

Until recently, arrogant, extreme scientific reductionism had significantly underestimated the complexity of not only the human psycho-physical organism but also the interconnectedness of all parts of complex dynamical systems, and of course the irony is, there is no such system as a non-complex one. This naivety is one of the reasons for the spectacular failure of both the creation of true artificial intelligence and artificial body organs.¹ This complex interconnectedness of the human psycho-physical organism is also the main reason why Uploading is science fantasy. I use Uploading with a capital U to distinguish between normal uploading of data and the special meaning given to it by Extropians.

In my paper, “Cyborgs, Uploading and Immortality: Some Serious Concerns,” I explored the possibilities of Uploading the mind, the complete contents of the human brain, to a more efficient and long lasting super-computational medium. Following this I discussed the consequent

possibility of Immortality.² The conclusion of this investigation showed the current Extropian concept of Uploading to be seriously flawed in principle, which has only been strengthened by subsequent research. The future of a cyborg existence is a rather different matter though. This paper does not discuss in great detail the possibility of the creation of artificially intelligent entities (seedAIs), which would be an entirely new species.³ Extropianism is the rather extreme end of the transhumanist movement, which seeks to transcend what they perceive to be the substantial limitations of human biological bodies.

Rodney Brooks, director of the MIT Artificial Intelligence Lab, is founder of the humanoid robotics group there. Note, humanoid implies a body similar to that of a human body. This group has made significant advances in the quest to create non DNA (biological) based intelligent entities over the past decade.⁴ One reason for their success is understanding that intelligence is not simply knowledge, lists of facts for example, but is developed through feedback systems such as that between a human infant and its parents. Simply stated, if we are to create an entity with intelligence and perhaps self-realization, this entity must *learn how* to become intelligent. As with all intelligent life this happens over time, through trial and error, within well established and recognized stages of development. Developmental psychology is one of the most important disciplines guiding humanoid robotics research. All of this work involves a situated body. These non-biological bodies vary in complexity depending upon the project goals.

One of Brooks' main motivations for this research is to answer his own question, "...what is it that *lets* matter transcend itself to *become* living?" [my emphasis].⁵ This question is of course one of the really hard fundamental ones and as such an important one to try and answer.

How is it that *seemingly* inert physical matter can become living? Here seemingly is the first key to the problem. Brooks in his question implies that matter is dead and consequently some thing *lets* matter transcend itself to become living. I would argue that matter is not dead, in fact, cannot ever be dead. An atom of sodium is a living entity. It may be rejoined that it depends on how we define living. My approach will become clearer as we proceed. The atom of sodium is a functioning system. It contains various parts which exist in harmony. It has a memory (albeit very small). It is energised by electrical force and it takes part, at times, in social activity. For example, when it binds to atoms of chlorine, it forms a more complex living entity (molecule) which we of course call salt. So, if we accept that

all matter, under a limited definition to be sure, is living then the question itself must be changed.

Perhaps a more accurate way of expressing what Brooks means would be to ask, "What is it that enables simple non-complex matter to display qualities such as consciousness and awareness of existence? The answer, in a word, is complexity.

Before addressing this concept in detail it is necessary to discuss memory briefly. I suggested above that we need to expand our definition of living. So too we need to expand our definition of memory. Memory is an essential attribute of self-awareness. With no memory from which to construct an internal story of continuity, we have no concept of who we are. This is not to say that memory alone is responsible for self-awareness. A simple electronic calculator has memory but it is unlikely that it is conscious of itself. Similarly an atom of sodium has memory. It remembers to maintain its homeostasis but again it is unlikely to be conscious of itself.

So, if we agree that all matter, in a limited sense, is living and all matter has memory. what is it that makes a human aware of itself and a lump of salt non-aware? I believe the answer is complexity: the greater the complexity the greater the *possibility* (and probability) that consciousness will arise from that complexity. Complexity is not synonymous with size. A tiny wren has a greater probability of being conscious than a mountain of salt because the mountain of salt is restricted to the limited complexity of its sodium and chlorine atoms.

The next concept I would like to introduce is that of a "functioning dynamical system." Again a pile of salt is in an extremely limited sense such a system. However, it is of partial complexity with only enough memory to maintain its atomic homeostasis, as it were. I propose that four attributes are essential for any entity before it can display evidence of self-awareness. They are: (a) have memory, (b) be a functioning dynamical system, (c) be of sufficient complexity, and (d) have some form of physical body. The complexity must apply to both memory and the feedback self-regulatory qualities of the system.

Memory alone seems not to be sufficient for the expression of consciousness. An entity must have connection and *interaction* with the environment in which it exists, apart from any other reason, simply so that it knows it is separate from the environment. This means situated embodiment, which is not to imply that any entity is an island unto itself though. Imitation and meme replication are essential precursors to self-awareness also. If there

is no realization of separateness there can be no sense of self other than that of a total universal self (the misguided goal of certain spiritual practices). If there is no individual self from which to transcend to become a universal self, then one cannot return to the individual self to be aware that anything has been transcended in the first place.

A word about self may be helpful before I continue. Blackmore has argued that the notion of a human's self is an illusion. This means, "... something that deceives by producing a false impression" not "something which does not exist." This is a very important point to realize because although our self is not a fixed 'I' which observes events and has experiences, the illusion of a self is not an illusion. As Blackmore argues, I believe correctly, if we are to produce a conscious machine, in our own image, it too will have an illusory self.⁶ So what? Our illusory self has served us well for countless years and must have had an evolutionary advantage over a non-illusory self or no-self, for us to be arguing about it today. The point surely is, is it possible to endow a non-DNA based entity with a sense of self, illusory or otherwise? Until we know the answer to this question we will have to work with our existing bodies.

There simply is not enough complexity in a "spark of consciousness" (whatever that is supposed to be) to exist in the ether and have awareness of a self. Similarly there is not enough complexity in a molecule of DNA to be self-aware. Its memory is just complex enough to carry out its coding-replication purpose, which in the case of human beings results in the extreme complexity of a functioning dynamical system *ready* to become self-aware after parturition.

Genetic modification of living beings and also modification of the germ cells, hence controlled manipulation of evolution, is slowly becoming a reality. This together with neural implantation and splicing electronics to animal nerve cells ensures that the future of humans, holocausts notwithstanding, will be a marriage of biological conventional human with various technological enhancements—human + machine = cyborg. It is also possible to state with some confidence that, even without artificial bits attached to our bodies, we are already cyborgs because of our intimate relationship with machines. This relationship becomes more concrete each day, especially for a large population of Western developed nations.

The *narrow* use of the term cyborg refers to an entity that is a combination of conventional biological (organic) and inorganic attributes. The addition of inorganic attributes may be divided into add-ons and implants. Add-ons

could be anything from false teeth to an artificial (removable) leg. Implants are such devices as Pacemakers and neural electronic brain ‘chips’, to alleviate such illnesses as Parkinson’s Disease. Consequently there are many cyborgs currently existing in the world. The difference between a human with a Pacemaker and a fully bionic entity with “silicone-chip-enhanced” brain, is perhaps only one of degree.

The question of longevity, and by extension immortality, is one of the most fundamental issues concerning both past and present human beings. I believe it is one of the main reasons for: (a) the development of all religions, (b) the practice of medicine and understanding of foods, and (c) the drive behind evolutionary survival and reproduction.

I have been interested in the concept of immortality for many years. I have thought deeply about the various possibilities and explanations humans have devised for surviving bodily death. I have also studied these belief systems both formally and informally for over forty years. I mention this simply to caution the reader that the following statement is not made lightly nor superficially. There is no reasonable, substantial evidence at all to support the concept of surviving physical death. Further, in all this research I have not found one convincing religious account, satisfactorily explaining the “problem of the existence of evil.”

The conclusion of this long search is that there appears to be no transcendent anthropic God, or gods in a religious sense. There is no soul in a religious or Platonic sense. There is no survival of the self (the illusion that we exist as a permanent entity) after bodily dissolution. There is no continuity of consciousness (again, self) in a Buddhist, Hindu or Quantum sense. There is nothing but a dissolving back into fundamental elements from which everything emerges and returns. *Finis*. Whilst I recognize and respect arguments against my conclusions, the point is that, if there is no survival, then the *techno*Metamorphosis of humans beings is the only possibility of achieving immortality.

A brief look at the most serious existing proposals for immortality may help for clarification. The most widespread belief in immortality is the spiritual one. That is, some sort of soul *thing*, which has memory continuity, leaves the physical body at death and moves on to exist in some other realm or spiritual universe. The numerous versions of this, from the big three monotheistic religions through to tribal ancestor spirits, all believe some ‘thing’ goes to a higher, or at least different, plane. The Buddhist canon is not at all clear as to this question. Some interpret Nirvana as “total dissolution

into the void.” Others see Nirvana as a sort of heavenly existence. The Hindu spiritual system(s) basically recognize reincarnation and eventual absorption into the Godhead, or more specifically, Brahman. The extinction of the *duality* of individual and Brahman is the ultimate goal; however, Brahman is neither an anthropic nor anthropomorphic concept. *Let me be quite clear about one thing: there either is or is not memory continuity of self after physical death.* “Of self” is of prime importance. If an entity cannot remember anything of its past existence, and never will be able to remember, but somehow still exists, then this is exactly the same as not existing at all from our perspective as existents in this present life.

If one chooses to believe in such transcendence scenarios, that of course is an individual’s right. However, this belief can only be based on personal revelation or faith. Faith or revelation may be a valid cognitive method; however, the resultant knowledge may not necessarily be factual.⁷ Consensus, replication and testability produce types of facts. Compare Advaita Vedanta, Christian and Shinto belief systems, regarding eschatology—no consensus in these.

The survival picture of occultists and parapsychologists involve such concepts as astral or subtle bodies, ghosts, spirit entities and near death experiences. Unfortunately none of these concepts can stand up to rigorous scientific or even logically coherent analysis. “The committee [National Research Council] finds no scientific justification from research conducted over a period of 130 years for the existence of parapsychological phenomena.”⁸

A further reasonably popular immortality concept is one in which the physical body, at a certain age—say when one was a healthy twenty-five-year-old—is resurrected. This concept has devotees both in religion and physics. The religious resurrection is bought about by of course God. The physicist’s version is at present posited as theoretically possible, though as I understand it, not testable, the practical aspects inconceivable. Very briefly the idea is that if every atom, molecule and the quantum state of a system at a precise instant are known, then that system may be reactivated as it were at any time, given the omnipotence of a transcendent being (God) or the technology being available. If the technological or transcendental means were available for such resurrection, what possible purpose would it serve? Why not grant immortality in the first place? More importantly, who would want to expend the energy in doing this or be able to justify such expenditure? Furthermore, and this is the serious point, unless the state of a person about

to be resurrected was known precisely at the age desirous of being resurrected then such resurrection is impossible. So, only if an individual's *total* state at, say, one second intervals had been continually logged throughout their lifetime would it be possible to retrieve the data of such state. Interestingly, long before computers and data analysis existed occultists described just such a data storage system which they call the Akashic Record. This spiritual data repository supposedly contains a record of everything that has ever happened and as such may be consulted to assess past lives and so on.

Tipler has *sort of* argued for this scenario in his book, *The Physics of Immortality*.⁹ Most of us, including myself, are not in the position to assess the validity of the high level mathematics used by physicists. I enlisted the help of a highly trained and experienced physicist to assess this aspect of Tipler's work. He not only reported that some of Tipler's physics and mathematics was "glaringly wrong" but that Tipler has seriously damaged his reputation in the field of physics through writing this particular book. From my own reading of the book, there are many sections which are incoherent and ignore the fundamental principles of logic, and Tipler's use of non sequiturs borders on the absurd. An excellent critique of this pseudo theology/physics has been made by Ellis and Stoeger.¹⁰ In short, there is no coherent argument I can find which supports the possibility of disembodied consciousness (of a self). No religion, spiritual system nor science (not even Quantum Theory of Immortality) that has one shred of evidence or can propose even a reasonable mechanism whereby consciousness of self can exist sans body.

It should be mentioned here that Cryonics attempts to hold the complex-system in suspension, more or less exactly in the state it was in, prior to temporary death, and before any system breakdown can occur. If the freezing and thawing problems of cryogenic storage can be sorted out, this "hanging about frozen solid for a few centuries" until a cure for one's temporary demise is found, may be a viable way to achieve extended longevity.¹¹

A further concept for achieving immortality is by copying an existing complex system to a more flexible—in respect of repair and further copying—medium. I return to this shortly.

It is taken as given by Transhumanists and Extropians that nonsurvival of physical death is the only reasonable and scientific possibility *at present*. It is in fact mainly this knowledge that drives transhumanists to attempt to overcome the end of personal existence caused by natural biological bodily

death. This paper does not discuss the desirability or otherwise of living longer or becoming immortal, nor the numerous ethical considerations involved. However, Unamuno's statement could almost be seen as throwing down the gauntlet to Extropians. "If it is nothingness that awaits us, let us make an injustice of it; let us fight against destiny, even though without hope of victory."¹² Technology seems the only conceivable hope of victory.

At present, this leaves us with the "three score and ten" cliché, a very short time indeed of conscious awareness (life) on this planet and in the universe. The unacceptability to us of this seemingly absurd situation, is really one of the main drives behind the search for meaning. Up until the 21st century there was simply nothing that could be done about it other than to develop comforting myths and pursue the fountain of youth through health fads and so on. Genetic engineering and bio-mimesis aided by computer science have finally offered a possibility for, if not immortality, then considerable longevity for those who so choose, or more correctly, have the knowledge and finances to live longer. Technically speaking, surviving bodily death is not synonymous with immortality. For the purposes of this essay the distinction is not especially relevant. If there is extinction there is no immortality. If there is survival we can worry about the specific issues of immortality from the "other side." I actually prefer to use the term *extended longevity* rather than immortality. This could be anything from five hundred to how-ever-many thousands of years, as this sidesteps the rather abstract "entropy of the universe" problem. This in turn avoids the philosophical issue of living forever which logically negates the possibility of individualism and any real purpose for living at all.

I believe, as previously mentioned, that Uploading the contents of the brain in one sitting is not possible, primarily because the *brain-mind-body is a unified system*. This does not mean that we will not be able to augment our existing brain with computer interfaces and neural implantation. This together with DNA and brain modification, chemical or electronic, so a system can continually repair itself, including regrowing lost limbs and organs, will be the first step towards an increase in longevity. Also replacing or repairing biological organs with new ones made from biological processes not high-tech materials may enhance longevity.

Biotech engineering applications fall into two categories: (a) modification to an existing living human, and (b) genetic manipulation of an existing human's germ cells so they pass on the changes to their offspring. Cultural development and artefacts affect evolution in indirect ways, though

memes are not passed on genetically. If, for example, a person is fitted with a titanium knee joint, polymer heart valves and a neural implant to increase falling hormonal levels, none of these attributes can be passed on to offspring and of course will be lost when the person dies. Cultural and sociological factors are important and powerful indirect modifiers of evolution, but it is the direct (fast) manipulation of humans to bring about permanent evolutionary changes that is a prominent Extropian and Transhumanist ideal.¹³

Clearly reproduction is the agent most implicated in evolutionary change. As long as humans remain human in a biological sense, modification of germ cells or using an individual's DNA for cloning is the only method of manipulating evolution. Specifically, until an entity, cyborg perhaps, can reproduce in an asexual way (digital/molecular copying for example), germ cell modification, cloning and indirect sociological evolutionary change are the only possibilities for controlling evolution. The majority of persons reading this paper will be between 15 and 90 years of age, so unless some method of increasing your chances of extended longevity are developed you will never see the results of such genetic and social manipulation. Of course if implantation and consequent regeneration of one's psycho-physical system becomes available *ad infinitum* then experiencing manipulated evolution will be a different matter.

The essential fundamental question is therefore: Is there anyway of copying an existing human *in toto*? I emphasise, *in toto*, because this is where the main fault lies in the Extropian and Transhumanist's notion of Uploading. They talk about Uploading the complete contents of the human brain, without clearly, if at all, defining what it is that constitutes a human mind. This theoretical, futuristic procedure is sometimes referred to as the "Moravec Transfer."¹⁴ The *mind is not the brain*, even if it was, where physically does the brain finish? Where does it start? The brain stem is certainly part of the thinking apparatus we call the brain, so I contend is the spinal cord and the central nervous system and one's various organs and limbs.¹⁵ As an example to illustrate the point, the retina at the back of the eye forms part of the brain's processing capability. The retina is not physically part of the brain though, "...low level feature extraction occurs in the retina."¹⁶ This means a fundamental aspect of seeing does not occur in the brain, so if only the brain itself is copied (Uploaded) the visual cortex will receive no *partly* decoded data!

Since the original draft of this paper I have found a body (no pun intended) of research which shows that the heart has a thinking function. Neurons similar to the brain's neurons exist in the heart and these enable it to process information and make decisions independent of the brain and also supply the brain with essential, *already* processed data.¹⁷ This further supports my contention that the mind is part of, or at least a function of, the complex brain-body dynamical system. So, it looks like the Extropians are going to have to upload the brain, together with retina, brain stem and heart, at minimum, to end up with anything like a resemblance of the original.

If it ever becomes possible to copy a human being, more or less *in toto*, then extreme longevity and designer entities would perhaps become possibilities. The only technological concept, presently conceived, that could possibly achieve this is nanotechnology. For those not familiar with the term, simplistically, nanotechnology refers to working with atoms and molecules at very small scales. By designing new, or manipulating existing molecules to do certain types of work or perform various functions it is in theory possible for those molecules *en masse* to perform work on the macro scale (for example, produce food or cure illnesses). It is the information carrying ability or memory of molecules that underpins the whole concept of nanotechnology. There is nothing esoteric or mysterious in that they do this, as every time a baby is born it is the memory of DNA molecules that allowed this to be possible. Adelman demonstrated experimentally that the data carrying abilities of molecules could be used to perform computation. He used DNA molecules as parallel linked computers to solve the Hamiltonian path problem successfully.¹⁸

Ironically, it is this ability of both atoms and molecules to have memory that has enabled me to assert with confidence that disembodied consciousness, that is, a notion of self, suspended in the ether as it were, is impossible. I use "embodied" in the broadest possible sense—a virtual body *may* still be a body. The reason for this conclusion is directly related to complexity, specifically system complexity.

An atom in an iron bar remembers its wholeness, that is, its electrons, protons, spin, charge and so on but it does not remember its position in the iron bar. There is simply not enough complexity in the atom of iron to remember more. If we combine the atom with another atom of a different element, say carbon, the resultant molecule has a higher degree of complexity and an increased level of memory. The point of this is that upon dissolution of a complex-system, say death of a tree, the various features such as leaves

and bark break down into cells, then into basic molecules, then perhaps into atoms. These various fundamental building blocks, the atoms of elements, may be reabsorbed by, for example, grass, then goats eating the grass, then humans drinking the goat's milk. The atoms of calcium that once were part of a tree's leaves have no idea that they were once part of a tree. They could have just as easily been part of a bone or a lump of limestone. It is only a *functioning-complex-system* that can be conscious that it is such a system. Where consciousness starts and finishes in the various living entities of our world is a matter of speculation. I suggest it is not a black and white situation and propose a sliding scale proportionate to the complexity of the agent's system.

So, when my old friend Harold Citizen takes his last breath, he ceases to have any possibility of awareness of his existence. The atoms and molecules that made up poor old Harold have no memory of him as a complex-system; they can only remember their own minute, extremely simple constitution. The complexity of Harold's system diminishes very rapidly after any essential component stops functioning.

One of the great hopes of nanotechnology is that extremely small molecular machines will be able to move through a human body, pinpoint the basis of a disease and rebuild the incorrectly functioning cells at a molecular level. Hence the development of nanotechnology is vitally important to the concept and practice of Cryonics, Uploading and extended longevity generally.

Regarding the copying of a complex-system, if a scanning process could copy, at minimum, every molecule and its relationship to its neighbouring molecules, then this data once stored in the new medium could be used to recreate, or at least simulate, the individual from which the data was taken. Many theoretical proposals have been put forward as to how this recreation-simulation-copying might be achieved, or better, encoded, perhaps this is merely a technical hurdle to overcome.¹⁹ However, if you want to achieve extended longevity for yourself, this means the new copy must of course have *memory continuity* and be a copy of the *total* you, not just a copy of your brain. There are some philosophers who go even further for personal survival than the mind-brain-body concept with memory continuity and insist that, "...bodily continuity is more essential to personal identity than memory continuity because memory claims can be true or false; thus memory *in itself* is not enough to make you the same person over time — bodily continuity is *required*."²⁰ I am arguing that *both* memory and bodily continuity are essential to personal survival.

Extropians and other proponents of Uploading are quite confident that scanning the entire brain will be possible in the future. If this is possible then it seems to me that scanning the rest of the body should also be a possibility and perhaps less intensive. The liver, pancreas, muscles and so on are somewhat less structurally complex than the brain, so while requiring more storage and simulation resources, a whole body should not present more difficulty in principle than just the brain. This of course would satisfy my objection to brain-only Uploading.

In addition to my argument for a unified brain-mind-body there are some other very important arguments against Uploading—either brains or whole body-mind systems. The *real* complex-system that is the human being is analogue not digital. Copying from analogue to digital is by no means an exact science and in fact may by its very nature be impossible to execute with perfect accuracy. The brain has aspects of its operation which are of a digital nature—the firing of a pulse along an axon for example; however, the overall brain cannot be considered digital. To confound the issue, the brain appears to be both digital and analogue.

A further related problem is that all dynamic systems are governed by the laws of Chaos, so perfect copying may be in principle impossible. Near enough is no where near good enough when attempting to reproduce a human mind in a different medium. This can be clearly illustrated by analyzing what happens when a deaf or partially deaf people have had their hearing restored with a cochlea implant. The literature is replete with anecdotes of the recipients wishing they never had the procedure done. Apparently the noise is almost unbearable until the brain learns to hear *again*, or worse, for the first time. “In a very literal sense, each developing brain region adapts to the body in which it finds itself.”²¹ This statement refers to a human (animal) brain from birth but illustrates the point that the brain does not automatically interpret sensory input data accurately without developmental feedback loops bootstrapping the brain, as it were, over time. And even then sensory inputs are interpreted approximately and idiosyncratically, within a consensus to be sure, but nevertheless, subjectively. A similar situation is apparent in those who have had blindness from birth corrected by surgery. See the work of Sacks for details.²²

Some argue that the bootstrapping only occurs until the brain is developed. Once this is complete the *operating system*, as it were, is so indelibly entrenched that no further bootstrapping is necessary. The development of the brain seems to decrease as we age, but I contend that it

is part of the functional nature of the brain to continually bootstrap itself. As an example, most of us when young have not adequately, if at all, developed the emotional abilities which are required to handle bereavement nor have we started to learn how to die. So even though the brain *structure* is present, its development is not complete. Damasio sums this up succinctly;

Genes provide for one brain component with precise structure, and for another component in which the precise structure is to be determined. But the to-be-determined structure can be achieved only under the influence of three elements: (1) the precise structure; (2) individual activity and circumstances ... (3) self-organising pressures arising from the sheer complexity of the system. The unpredictable profile of experience of each individual does have a say in circuit design.²³

Replacing the human ears with say, parabolic microphones as auditory input devices for a newly Uploaded mind, would cause similar if not greater hearing chaos than the previously mentioned cochlea implant—similarly with all sensory input devices. The brain is not a digital computer with peripheral input-output devices, nor is the *mind* the sum total of stored on-off states in the brain. What we call our self is a unity of brain and body and external environment. The *experienced* external environment from birth—from which the developing brain, through socialization and enculturation learns to hear and see and feel—is very much part of our self. This is also an extremely important point to be considered in the development of artificial intelligence.

Our individual fleeting consciousness (+ nonconsciousness) exists only because of the body from which it arises and from which it dissolves at the time of bodily demise. Consequently sensory input to a body is of extreme importance in the quest to create a self-aware AI. If it was possible to scan the entire human body, then our peripheral sensors need to be similar *prior* to the Upload scanning. In other words a pre-scan period would require replacement of our biosensors (eg. ears replaced with microphones and transducers). When fully scanned the new software brain would be fed from these *same* sensors. This means the period that would be essential for brain adjustment (re-learning) would have been done slowly in the pre-scan stage. This is essential because without this period of adjustment a brain would become a mass of out-of-control electrical conductivity if suddenly the biosensors were replaced with artificial ones.

So, to create a self-aware machine we need to construct one which can store memory, is a functioning dynamical system interacting with both its own internal environment and the external environment, and has *the ability to learn and react* to various sensory inputs. If an AI entity is to interact at all with us, it must have some input from the external real environment. I do not think it would be sufficient to run the whole AI as software only, similar to Alife programs. If this experimental research is to lead to super intelligent AI entities interacting with humans in the real world, then they will require some sort of body and mobility. This lands us squarely back to my assertion, mentioned previously, that disembodied consciousness is impossible.

So, will copying or Uploading a whole person be possible? The truthful answer is that nobody really knows at this time and nobody will really know until it is attempted. The first successes in nanotechnology are being reported. The successful neural splicing of an electronic chip into a researcher's arm, which when connected to a robotic arm can be controlled by the researcher's thoughts, has already happened.²⁴ These are small, though significant technical breakthroughs and in my opinion show that *some* forms of nanotechnology will be practically viable, probably in the near future. Of course the benefits of nanotechnology may be outweighed by the equally possible devastating effects this technology could have.

If *You* want to live significantly longer than "three score and ten," then your only possibilities at present are to support nanotechnology research to help get it up and running before you die and or to make Cryonic arrangements so you can be *suspended* until nanotechnology or some other technologies become viable. In the words of Dylan Thomas, "Do not go gentle into that good night. Rage, rage against the dying of the light."

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¹⁹ Moravec, H op cit. also *The Low Beyond* 2001 Yudkowsky, E.S. Section 4. Uploading. <http://sysopmind.com/singularity.html>

²⁰ Augustine, K. 1997 *The Case against Immortality* kaugust@infidels.org Originally published in *Skeptical Magazine* vol.5. no. 2. (citing Edwards pp.48-49)

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²³ Damasio, A.R. 1994 *Descartes' Error. Emotion, Reason and the Human Brain*. Papermac, Macmillan, London.

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